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National Advisory Committee for Aeronautics

Research Abstracts

ABSTRACTS NO. 1 **JUNE 15, 1951**

NACA RM E51C28

National Advisory Committee for Aeronautics. LIMITS OF FLAMMABILITY OF PURE HYDROCARBON AIR MIXTURES AT REDUCED PRESSURES AND ROOM TEMPERATURE. James T. DiPiazza. May 25, 1951. 25p. diagrs., tab. (NACA RM E51C28)

The flammability limits of pure hydrocarbon-air mixtures at reduced pressures are reported for 17 normal paraffins, branched paraffins, and monoolefins. The range of flammable mixtures, when expressed as percent stoichiometric fuel, increased with molecular weight. The effect of branching was to decrease the flammability range. Saturation, ethylene excepted, had no significant effect. The low-pressure limit of flame propagation was relatively unaffected by molecular weight, branching, or unsaturation.

NACA TM 1295

National Advisory Committee for Aeronautics. GAS FLOW WITH STRAIGHT TRANSITION LINE. (Ob Odnom Gazovom Techenii s Priamoi Liniei Perekhoda). L. V. Ovsiannikov. May 1951. 13p. diagr. (NACA TM 1295. Trans. from Prikladnaya Matematika i Mekhanika, v.13, 1949, p.537-542).

An investigation was conducted on the limiting case of a gas flow when the constant pressure in the surrounding medium is exactly equal to the critical pressure for the given initial state of the gas.

NACA TN 2346

National Advisory Committee for Aeronautics. AN ITERATIVE TRANSFORMATION PROCEDURE FOR NUMERICAL SOLUTION OF FLUTTER AND SIMILAR CHARACTERISTIC-VALUE PROBLEMS. Myron L. Gossard. May 1951. 75p. diagrs., 9 tabs. (NACA TN 2346)

The idea of the iterative transformation procedure suggested by H. Wielandt is explained. Application of the procedure to ordinary natural-vibration problems and to flutter problems is shown in numerical examples. Comparisons of computed results with experimental values and with results obtained by other methods of analysis are made.

NACA TN 2357

National Advisory Committee for Aeronautics. METHOD FOR CALCULATION OF RAM-JET PERFORMANCE. John R. Henry and J. Buel Bennett. June 1951. 95p. diagrs., 2 tabs. (NACA TN 2357)

A method utilizing precalculated solutions graphically presented for calculating subsonic or supersonic ram-jet thrust coefficients and other important quantities is presented with the associated equations and graphs. Using the assumption of constant values of specific-heat ratio and gas constant equal to those of standard air, the thrust-coefficient calculation has been reduced to a few simple operations. Correction methods are presented to account for variations in specific-heat ratio and gas constant. The correction to the thrust coefficient for a typical set of operating conditions may be of the order of 5 to 10 percent.

NACA TN 2367

National Advisory Committee for Aeronautics. GENERAL PLASTIC BEHAVIOR AND APPROXIMATE SOLUTIONS OF ROTATING DISK IN STRAIN-HARDENING RANGE. M. H. Lee Wu. May 1951. 56p. diagrs., 5 tabs. (NACA TN 2367)

A partly linearized solution of plastic deformation of a rotating disk is obtained and used to investigate general plastic behavior of this problem. An approximate method is also given. Principal stress and strain distributions are obtained by these two methods by a simple multiplication and agree very well with the exact solution previously obtained.

NACA TN 2369

National Advisory Committee for Aeronautics. TORSION AND TRANSVERSE BENDING OF CANTILEVER PLATES. Eric Reissner and Manuel Stein. June 1951. 39p. diagrs. (NACA TN 2369)

The problem of combined bending and torsion of cantilever plates of variable thickness, such as might be considered for solid thin high-speed airplane or missile wings, is considered. The deflections of the plate are assumed to vary linearly across the chord; minimization of the potential energy by means of the calculus of variations then leads to two ordinary linear differential equations for the bending deflections and the twist of the plate. Because the cantilever is analyzed as a plate rather than as a beam, the effect of constraint against axial warping in torsion is inherently included.

NACA TN 2370

National Advisory Committee for Aeronautics. MATRIX METHOD OF DETERMINING THE LONGITUDINAL-STABILITY COEFFICIENTS AND FREQUENCY RESPONSE OF AN AIRCRAFT FROM TRANSIENT FLIGHT DATA. James J. Donegan and Henry A. Pearson. June 1951. 29p. diagrs., 3 tabs. (NACA TN 2370)

A method is presented for obtaining the over-all longitudinal-stability coefficients and frequency response of an aircraft from an analysis of arbitrary maneuvers in which simple instrumentation is used. Although the method presented deals entirely with the aircraft, it is equally applicable to other problems which can be expressed by second-order differential equations.

NACA TN 2371

National Advisory Committee for Aeronautics. POSSIBLE APPLICATION OF BLADE BOUNDARY-LAYER CONTROL TO IMPROVEMENT OF DESIGN AND OFF-DESIGN PERFORMANCE OF AXIAL-FLOW TURBOMACHINES. John T. Sinnette, Jr. and George R. Costello. May 1951. 32p. diagrs. (NACA TN 2371)

A theoretical discussion of the application of blade boundary-layer control to increase the efficiency and the stage pressure ratio and to improve off-design performance of compressors and turbines is presented. A method is developed for designing suction, or ejection, slotted blades with a prescribed velocity distribution along the blade and in the slot. The effect of the boundary layer on the design of the slot and the effect of ejecting gas at stagnation pressures and temperatures different from free-stream values are discussed.

NACA TN 2373

National Advisory Committee for Aeronautics. PRACTICAL METHODS OF CALCULATION INVOLVED IN THE EXPERIMENTAL STUDY OF AN AUTOPILOT AND THE AUTOPILOT-AIRCRAFT COMBINATION. Louis H. Smaus and Elwood C. Stewart. June 1951. 26p. diagrs. (NACA TN 2373)

Presents practical methods for making the various calculations required for the analysis of an autopilot and an autopilot-aircraft combination from frequency response data. Equations are derived for determining the servo-system error voltage for both displacement input signal and displacement plus rate of displacement input signal, the autopilot frequency response for addition of rate of displacement input signal, the servo-system frequency response for a change of gain, and the relation between open-loop and closed-loop frequency responses for the servo system and for the autopilot-aircraft combination.

NACA TN 2374

National Advisory Committee for Aeronautics. EFFECT OF INITIAL MIXTURE TEMPERATURE ON FLAME SPEED OF METHANE-AIR, PROPANE-AIR AND ETHYLENE-AIR MIXTURES. Gordon L. Dugger. May 1951. 30p. diagrs., photo., 3 tabs. (NACA TN 2374)

Flame speeds of methane-air mixtures and ethylene-air mixtures were determined as functions of mixture composition at initial mixture temperatures ranging from 34° to 344° C by a Bunsen-Burner method. The data were compared with reported data for propane and air; the maximum flame speeds increased with temperature at increasing rates and were affected on the percentage basis in the decreasing order, methane, propane, and ethylene. Both a thermal and diffusion theory predicted the effect of temperature on maximum flame speed within 20 percent. Straight-line correlations were found between maximum flame speed and calculated equilibrium hydrogen-atom concentration (at adiabatic flame temperature) for each fuel.

NACA TN 2375

National Advisory Committee for Aeronautics. ON THE USE OF COUPLED MODAL FUNCTIONS IN FLUTTER ANALYSIS. Donald S. Woolston and Harry L. Runyan. June 1951. 13p. diagrs., 2 tabs. (NACA TN 2375)

An investigation of the flutter characteristics of a uniform, unswept, cantilever wing of high aspect ratio and under conditions of high mass coupling has been made by means of an analysis of the Rayleigh type based on coupled modal functions. Results are compared with those of an analysis based on uncoupled modes and with experiment. For the configuration studied, the use of coupled modes was found to yield, in general, no better agreement with experiment than did the use of uncoupled modes.

NACA TN 2376

National Advisory Committee for Aeronautics. METHOD FOR ANALYZING INDETERMINATE STRUCTURES STRESSED ABOVE PROPORTIONAL LIMIT. F. R. Steinbacher, C. N. Gaylord and W. K. Rey, University of Alabama. June 1951. 47p. diagrs., photos., 3 tabs. (NACA TN 2376)

An analytical method based on successive approximations is presented for determining the loads and deflections throughout an indeterminate structure in which one or more of the members have been stressed beyond their proportional limits. Theoretical analyses of three structures are compared with tests and found to agree very closely. For the sake of simplicity and clarity, only coplanar pin-ended structures have been analyzed and tested.

NACA TN 2378

National Advisory Committee for Aeronautics. AUTOMATIC CONTROL SYSTEMS SATISFYING CERTAIN GENERAL CRITERIONS ON TRANSIENT BEHAVIOR. Aaron S. Boksenbom and Richard Hood. June 1951. 45p. diagrs. (NACA TN 2378)

An analytical method is presented for the design of automatic controls that starts from certain arbitrary criterions on the behavior of the controlled system and gives those physically realizable equations that the control system can follow in order to realize this behavior. The criterions used are in the form of certain time integrals. General results are shown for systems of second order and of any number of degrees of freedom. Detailed examples for several cases in the control of a turbojet engine are presented.

NACA TN 2384

National Advisory Committee for Aeronautics. PRELIMINARY INVESTIGATION OF WEAR AND FRICTION PROPERTIES UNDER SLIDING CON-

DITIONS OF MATERIALS SUITABLE FOR CAGES OF ROLLING-CONTACT BEARINGS. Robert L. Johnson, Max A. Swikert and Edmond E. Bisson. June 1951. 33p. diagrs., photos., tab. (NACA TN 2384)

The wear and the friction of brass, bronze, beryllium copper, monel, Nichrome V, 24S-T aluminum, nodular Iron, and gray cast iron sliding against hardened SAE 52100 steel were studied.

NACA TN 2386

National Advisory Committee for Aeronautlcs.
STUDIES OF HIGH-TEMPERATURE PROTECTION OF A TITANIUM-CARBIDE CERAMAL BY CHROMIUM-TYPE CERAMIC-METAL COATINGS. Dwight G. Moore, Stanley G. Benner and William N. Harrison, National Bureau of Standards. June 1951. 24p. diagrs., photos., 8 tabs. (NACA TN 2386)

Four ceramic-metal coatings of varying frit content were prepared and applied to ceramals containing 80 percent chromium and 20 percent cobalt. Oxidation penetration, transverse breaking load, and thermal shock resistance of the various specimens were determined after prolonged heating in air at temperatures of 1650°, 1800°, 2000°, and 2200° F. The effects of varying firing time, firing temperature, and number of coats applied were studied for one coating.

N-3255*

Cornell U. Graduate School of Aeronautical Engineering.
ON THE STABILITY OF TWO-DIMENSIONAL SMOOTH TRANSONIC FLOWS. Yung-Huai Kuo and Tien-Fun Sun. September 15, 1950. 33p. diagrs. (Cornell U. Graduate School of Aeronautical Engineering)

Presents a theoretical investigation of the stability of two-dimensional, smooth transonic flows. Disturbances are introduced and their future course is traced. The disturbance considered is a finite linear pulse, moving up-stream, with a weak discontinuity at its head or tail. Only the compression type of pulse is considered. It is assumed that all the disturbances are locally produced, but the wave front is already developcd into a plane and is limited in extent laterally. The motion of the disturbances is assumed to be isentropic and irrotational.

N-4685*

National Bureau of Standards.
CORROSION BEHAVIOR OF TITANIUM AND SOME TITANIUM ALLOYS. Fred M. Reinhart. (Progress rept. 1) December 21, 1950. 22p. diagrs., photos., 6 tabs. (National Bureau of Standards)

Stress corrosion tests in both urban and marine atmospheres were started on carbon free "commercially pure" and on 0.3 percent carbon "commercially pure" titanium, and on a titanium alloy containing 1.86 percent chromium. Stresses were applied both longitudinally and transversely to the direction of rolling of the sheet at values equivalent to 70, 80, and 90 percent of the yield strengths of the materials. Panels of carbon free titanium, after spot welding, after arc welding, and in contact with dissimilar metals were exposed in urban and marine atmospheres as well as In the tldewater.

N-7110*

THE PHYSICAL BASIS OF THE MATHEMATICAL THEORY OF THE PLASTICITY OF METALS. (Fizicheskie Osnovy Matematicheskoi Teorii Plastichnosti Metallov). N. A. Artemiev. 36p. diagrs. (Trans. from Zhurnal Eksperimentalnol i Teoreticheskoi Fiziki, v.5, no. 7, 1935, p.563-584).

An expository paper in which a critique is presented of the various mathematical theories of plasticity developed by different authors. Stress is laid on the extreme physical complexity of the phenomenon (strain hardening, velocities of deformation, irreversibility, statical indeterminateness) and the great divergence of properties of materials; hence the restricted applicability of any partlcular theory. It is stated that, taking into account all considerations, principles may be given on the basis of which a new theory of plasticity of metals, free from the deficiencies mentioned, may be constructed.

N-7527*

Massachusetts Inst. of Tech.
AN INVESTIGATION OF THE POSSIBILITY OF DETERMINING STATIC PRESSURE ANOMALIES OVER MOUNTAINOUS TERRAIN BY THE USE OF A SCALE-MODEL IN A WIND TUNNEL. H. G. Houghton and A. B. Buck. (Final rept.) November 10, 1950. 73p. diagrs., photo. (Massachusetts Inst. of Tech.)

Errors in pressure-altimeter Indications may be of human, instrumental, meteorological or aerodynamic source. An attempt was made to study these aerodynamic errors in a wind tunnel, and correlate the findings with those of an in-flight investigation. The flow pattern is believed to be a useful approximation, but comparisons show wind tunnel results differ in sign and magnitude from those observed in flight. It is probable that computations of static pressure based on observed flow may lead to better results.

5001.3-947*

Polytechnic Inst. of Brooklyn.
NUMERICAL ANALYSIS OF THE STRESSES IN A SWEPT BOX BEAM. V. L. Salerno, B. Levine and H. Liebowitz. November 1949. 80p. diagrs., 2 tabs. (Polytechnic Inst. of Brooklyn)

A method is presented for calculating the stress distribution in a swept box beam. The method is applied to a beam in which all transverse ribs are assumed rigid and to the same beam when the ribs attached to the fuselage are assumed elastic. The simultaneous linear equations obtained are solved by iteration. The results agree satisfactorily with tests carried out by the NACA.

BRITISH

N-6962*

Aeronautical Inspection Directorate (Gt. Brit.)
A STATISTICAL REPORT ON THE MECHANICAL PROPERTIES OF SAND CAST STANDARD TEST SAMPLES IN MATERIAL TO SPECIFICATION D. T. D. 133C. Margaret D. H. Wright and R. A. Nowlan. November 1950. 8p. diagrs., 2 tabs. (AID Rept. H. Q. 3)

A statistical examination has been made of the acceptance test results in D. T. D. 133C material from five founders, during half-yearly periods ending September 1947, and March 1949. The founders' test results are compared with A.I.D. check tests results on test samples from normal positions. A typical stress-strain curve has been prepared from A.I.D. test values.

N-5616*

Aeronautical Research Council (Gt. Brit.)
MEASUREMENT OF THRUST AND TORQUE GRADING ON HIGH-PITCH MODEL AIRSCREWS. C. N. H. Lock, H. Bateman and H. L. Nixon. 1950. 29p. diagrs., 4 tabs. (ARC R & M 2477. Formerly ARC 4166)

It was desired to measure thrust and torque grading on high pitched model airscrews at low tip speed by means of combined yaw and total pressure tubes. Experiments were mainly concerned with the stalled range of the airscrew in which the standard methods of strip theory based on aerofoil tests have been unsuccessful. Four model screws were tested. (1) Two-bladed "Goldstein" model; (2) and (3) Two-bladed airscrew of the "family of airscrews" of 1.5 times the standard blade width and the corresponding four-bladed airscrew of 0.75 times the standard blade width; (4) Model of a two-bladed airscrew designed for the 1931 Schneider Trophy contest.

N-5618*

Aeronautical Research Council (Gt. Brit.)
A SUGGESTED METHOD OF INCREASING THE DAMPING OF AIRCRAFT STRUCTURES. D. H. D. Cooper. 1950. 13p. diagrs., photos., 4 tabs. (ARC R & M 2398; ARC 10,166. Formerly RAE SME 3382)

The object of this work is to find means of increasing damping in the joints of a structure, similar to a riveted structure, by the use of plastic inserts in the joints. Information on the effect of pressure-cabin sealing and the adoption of spot-welded or Redux welding construction is also given. This report discusses the operation of an insert and the properties called for in service, and recommends four suitable materials for further tests. The apparatus used to compare the damping of inserts made from a number of different materials is described.

N-5672*

Aeronautical Research Council (Gt. Brit.)
THE DETERMINATION OF THE FIXED ROOT FREQUENCIES OF PROPELLER BLADES USING SCALE MODELS AND THE RESULTS COMPARED WITH CALCULATIONS. G. A. Luck and W. Lowes. 1950. 10p. diagrs., photos., 2 tabs. (ARC R & M 2391; ARC 9392. Formerly RAE Tech. Note Vib. 16)

Model blades of known propeller designs, one one-tenth and the other a one-fifth scale, were bowed to investigate their fixed-root natural frequencies and modes of vibration. Similar experiments on a cylindrical bar having the same root form were carried out to investigate the root fixation. Calculation of the lower natural frequencies of the blades was made. Very good agreement between the experimental and calculated frequencies was obtained.

N-5673*

Aeronautical Research Council (Gt. Brit.)
SPAR DEPTH AND WEIGHT. W. Tye and R. G. Thorne. 1950. 3p. diagrs. (ARC R & M 2569. Formerly RAE SME Dept. Note 23)

In design of aircraft spars, where weight saving is of primary importance, and where too low a flexural stiffness might be a disadvantage, the greatest spar depth and the shortest span consistent with good aerodynamic properties are used. In wing design, it is customary to consider aspect ratio and thickness/chord ratio as primary design parameters. The influence on wing weight of changes of either of these quantities is associated mainly with their effect on the semispan/spar-depth ratio. Therefore, it is convenient to consider the ratio of wing semispan to root thickness as the basic design parameter.

N-7174*

Aeronautical Research Council (Gt. Brit.)
FREE-FLIGHT TESTS ON KITES IN THE 24-FT WIND TUNNEL. S. B. Jackson. 1951. 18p. diagrs., photo., 7 tabs. (ARC R & M 2599. Formerly RAE Aero 1737)

Tests were conducted on six kites over a greater range of wind speed than for previous large-tunnel tests. The tests were made over the whole stable range of the kites and up to the highest safe wind speed. The kites were flown from a pylon and values of lift, drag and incidence of the forward and rear bridles were measured. Attempts were also made on two of the 3-ft kites to improve their stability at higher wind speeds and low incidences.

N-7175*

Aeronautical Research Council (Gt. Brit.)
FLIGHT TESTS OF A YOUNGMAN FLAP ON FAIREY P.4/34. K.7555. M. B. Morgan and D. E. Morris. 1951. 14p. diagrs., photos., 3 tabs. (ARC R & M 2547; ARC 5281. Formerly RAE BA 1687)

These flaps are of the external airfoil type, and can be lowered to two positions, one giving medium lift

and low drag for take-off, the other (similar to a Fowler flap) giving high lift and drag for landing. $C_{L_{max}}$ was determined when gliding and at full throttle. Glides and partial climbs were made in order to establish lift and drag curves. From the experimental results, the effect of flap setting on the minimum radius of horizontal turn was estimated. Further tests were made to determine the effect of adding an extra 12.1 sq. ft. to the flap area at the center-section.

N-7176*

Aeronautical Research Council (Gt. Brit.)
THE CASE FOR FACTORS OF SAFETY OF 1.5 INSTEAD OF 2.0, WITH SPECIAL REFERENCE TO THE FLIGHT ENVELOPE. P. E. Montagnon. 1951. 6p. diagrs. (ARC R &M 2578. Formerly RAE Tech. Note SME 211)

The purpose of this note is to show the desirability of using a factor of safety of 1.5 throughout all design strength requirements, in particular in the first instance for all requirements directly connected with the symmetric flight envelope. Alongside this is shown the desirability of changing the flight envelope to agree more nearly with results obtained in practice (from V-g records).

N-7177*

Aeronautical Research Council (Gt. Brit.)
WIND-TUNNEL TESTS ON THE EXPERIMENTAL HIGH LIFT M.18. R. Hills, E. C. Brown, M. A. Morrison and H. V. Becker. 1951. 13p. diagrs., 10 tabs. (ARC R & M 2453; ARC 6001. Formerly RAE Aero 1760)

Wind-tunnel tests have been made on an experimental high-lift design with a 40 percent chord slotted flap, inset ailerons and full-span leading-edge slats. The measurements were made with flaps down only, and included:--(1) Effect of slipstream on longitudinal stability and trim. (2) Yawing and rolling moments due to sideslip. (3) Rudder power with and without slipstream.

N-7237*

Aeronautical Research Council (Gt. Brit.)
NOTE ON THE LIFT AND PROFILE DRAG EFFECTS OF SPLIT AND SLOTTED FLAPS. A. D. Young and P. A. Hufton. 1951. 20p. diagrs., 4 tabs. (ARC R & M 2545; ARC 5472. Formerly RAE BA 1707)

The existing data have been analysed and a method has been derived for predicting the lift and profile-drag increments of split and slotted flaps. It is suggested that the probable order of error involved in the method is within the accuracy required for most practical purposes. It is found that the profile-drag increments of split flaps on wing-body combinations is somewhat lower than on wings alone, while the converse is true for slotted flaps. Nevertheless, the available data from which these results are derived are scanty and most are comparatively unreliable.

N-7238*

Aeronautical Research Council (Gt. Brit.)
THE INDUCED DRAG OF FLAPPED ELLIPTIC WING WITH CUT-OUT AND WITH FLAPS THAT EXTEND THE LOCAL CHORD. A. D. Young. 1951. 12p. diagrs., tab. (ARC R & M 2544; ARC 6259. Formerly RAE Aero 1732)

Calculations were made of the induced drag of flapped elliptic wings covering a range of aspect ratios from about 4 to about 12, a range of flap spans from 0.2 to 1.0 of the wing span, and a range of flap cut-outs from 0 to 0.6 of the wing span. Calculations were also made of the induced drag of elliptic wings of aspect ratio of about 6 with flaps that extend the local chord by 40 percent when in operation; flap spans of 0.26, 0.5, and 0.77 of the wing span were examined. These results apply strictly to elliptic wings but they probably apply with fair accuracy to wings of taper ratio of the order of 2:1.

N-7239*

Aeronautical Research Council (Gt. Brit.)
WIND TUNNEL TESTS ON THE SUPERMARINE S. 24/37, A HIGH-WING MONOPLANE WITH A VARIABLE-INCIDENCE WING. H. Davies, J. E. Adamson and J. Seddon. 1951. 39p. diagrs., 29 tabs. (ARC R & M 24^{c}1; ARC 5107. Formerly RAE BA 1660)

Wind-tunnel tests have been made on the Supermarine S. 24/37 to investigate characteristics associated with the variable-incidence wing, which is a novel feature of this design. The main purpose of the tests was to determine: - (1) Changes in longitudinal trim due to altering the wing setting in flight, engine on or off. (2) Elevator effectiveness during landing and take-off. In addition routine tests were made on longitudinal stability, engine on and off, and a general investigation of ground effect with slipstream was also included.

N-7240*

Aeronautical Research Council (Gt. Brit.)
NOTE ON WIND-TUNNEL MEASUREMENTS OF YAWING MOMENT, RUDDER FIXED AND FREE, ON MODELS OF THREE AIRCRAFT. J. E. Adamson, E. C. Brown and R. H. Allen. 1951. 16p. diagrs., 5 tabs. (ARC R&M 2534; ARC 5289. Formerly RAE BA 1674)

Yawing moments and rudder power were measured with rudder fixed and free on models of the Sunderland, Halifax and Lancaster. In some cases rolling moment and side force were measured, the latter quantity being useful for calculations of flat turning radii. The tests include variations of rudder balance. The fin and rudder data have been compared with previous results for single and double fins and rudders.

N-7267*

Aeronautical Research Council (Gt. Brit.)
PROPELLER BLADE VIBRATION: NATURE AND SEVERITY OF VIBRATION AT EDGWISE RESONANCE AS INFLUENCED BY COUPLING

EFFECTS DUE TO BLADE TWIST. J. F. Shannon and J. R. Forshaw. 1950. 10p. diagrs. (ARC R & M 2561; ARC 5198. Formerly RAE E. 3843)

Information was required as to the stress distribution in propeller blades occurring at edgewise resonance, and the importance of this vibration relative to the other modes. Tests were carried out on a duralumin-bladed propeller so mounted that the dynamical system was equivalent to an engine and propeller subjected to engine torsional oscillation. The fundamental edgewise vibration and its interaction with the adjacent second overtone flapping vibration was investigated for non-rotating conditions.

N-7268*

Aeronautical Research Council (Gt. Brit.)
THE DESIGN OF FANS AND GUIDE VANES FOR HIGH-SPEED WIND TUNNELS: W. A. Mair. 1951. 27p. diagrs. (ARC R & M 2435; ARC 7988. Formerly RAE Aero 1949).

The methods which have been used in designing fans for low-speed tunnels require some modification when the speed of the tunnel is increased. This report describes the method which has been used at the Royal Aircraft Establishment in designing fans and guide vanes for wind tunnels having maximum speeds above about 300 ft per sec. The effects of compressibility and blade interference are considered in detail and the method of design is fully explained.

N-7269*

Aeronautical Research Council (Gt. Brit.)
THE EFFECT OF MODEL SIZE MEASUREMENTS IN THE R.A.E. HIGH SPEED TUNNEL. DRAG OF TWO-DIMENSIONAL SYMMETRICAL AEROFOILS AT ZERO INCIDENCE. W. A. Mair and H. E. Gamble. 1951. 15p. diagrs., tab. (ARC R & M 2527; ARC 8372. Formerly RAE Aero 1998)

Pitot traverse drag measurements were made at zero incidence on three NACA 0015 airfoils of different sizes. Pressures at the tunnel walls were also measured. Tests were made at two different Reynolds numbers by changing the tunnel pressure. From the results it has been possible to separate the effects of varying Reynolds number and tunnel wall interference. It has been shown that blockage corrections in current use are not large enough to equalize drag measurements made on different sizes of airfoil at the same Reynolds number.

N-7270*

Aeronautical Research Council (Gt. Brit.)
ANALYSIS OF STRAIN GAUGE MEASUREMENTS ON BARRACUDA REAR FUSELAGE - ARRESTED LANDING LOADING CONDITION. D. C. Allen. 1951. 6p. diagrs. (ARC R & M 2390; ARC 9189. Formerly RAE Tech. Note SME 338)

Strain measurements made during a static strength test on a Barracuda V fuselage under arrested landing loading conditions have been compared with the stresses given by a theoretical analysis of the problem. End-loads calculated for a circular cylinder subjected to similar loading and shears determined by the same method, but corrected for the effect of the tapering fuselage form the basis for the comparison. Direct stress at two sections of the fuselage and shear strains at one section have been examined.

N-7271*

Aeronautical Research Council (Gt. Brit.)
WIND-TUNNEL TESTS ON THE SHETLAND. C. H. E. Warren and R. E. W. Harland. 1951. 25p. diagrs., 15 tabs. (ARC R & M 2571. Formerly RAE Aero 1780)

Wind-tunnel tests were made to obtain aerodynamic data on the Shetland. The following measurements were made: (1) lift, drag and pitching moment for various conditions of the model over the complete flight range, with flaps up and down (2) directional and lateral stability (3) elevator, rudder and aileron effectiveness (4) effect of return-flow nacelles on lift and pitching moment.

N-7272*

Aeronautical Research Council (Gt. Brit.)
A NOTE ON THE TENSILE STRENGTH AND ELONGATION OF WIDE PLATES OF ALUMINUM ALLOY WITH AND WITHOUT HOLES. H. E. Smith and H. L. Cox. 1951. 8p. diagrs., 3 tabs. (ARC R & M 2429. Formerly ARC 6438; ARC 7976; ARC Strut 651)

The investigation was to determine the effect of small holes, such as inspection holes, in reducing the effective tensile strength of aluminum alloy sheet, and to examine the efficiency of two types of reinforcement. Tensile tests have been made on plates 10 inches and 13 inches wide cut from sheets of 16,20 and 24 s.w.g. The series of test pieces comprised one set plain without holes, one set with a 3-inch diameter hole in the middle of the test length, one set with the same hole reinforced at the edge by a cover ring riveted on, and three sets with the hole reinforced by pressed flanges of three different depths.

N-7281*

Aeronautical Research Council (Gt. Brit.)
FLUTTER OF CONTROL SURFACE TABS. G. A. Naylor. 1951. 12p. diagrs. (ARC R & M 2606. Formerly RAE SME 3210)

Oscillation of control-surface tabs has occurred in flight. General experience and the investigations of this report suggest that the oscillations were flutter, involving translation of the tab, arising from bending of the local control-surface structure, coupled with rotation of the tab about its hinge, arising from either backlash or elasticity of the tab controlling mechanism. Binary flutter calculations show that, for this coupling, the normal remedy, i.e. mass-balancing, is only partially effective. If the tab controlling mechanism is adequately stiff, elimination of backlash gives higher flutter speeds than would be obtained by mass-balancing alone and in practice probably removes the danger of flutter. Flutter is completely prevented by aerodynamically balancing and dynamically mass-balancing the tab.

N-7282*

Aeronautical Research Council (Gt. Brit.) THE EFFECT OF TAB MASS-BALANCE ON FLUTTER. PART I. TERNARY TAILPLANE - ELEVATOR - TAB FLUTTER. G. H. L. Buxton and G. D. Sharpe. PART II. EXPERIMENTS ON THE INFLUENCE OF TAB MASS-BALANCE ON FLUTTER. C. Scruton, P. M. Ray and D. V. Dunsdon. 1951. 18p. diagrs. (ARC R & M 2418; ARC 10,405. Formerly RAE SME 3390; ARC 9883)

Following an accident to a Mosquito fitted experimentally by the RAE with a g-restriction device involving heavy mass-overbalance of an elevator tab, an investigation has been made into the flutter characteristics of tailplanes carrying elevators and tabs. The degrees of freedom considered were vertical bending of the fuselage, elevator rotation and tab rotation. The tab was assumed to be spring-connected to the elevator, while the elevator was taken to be free. The effect of variation of the stiffness ratio, of the states of mass balance of the tab and elevator, and of horn balance of the elevator, was investigated.

N-7283*

Aeronautical Research Council (Gt. Brit.) TESTS ON THICK CUFF SECTIONS IN THE COMPRESSED AIR TUNNEL. D. H. Williams and A. F. Brown. 1951. 8p. diagrs., tab. (ARC R & M 2457. Formerly ARC 5913; ARC AP 333; ARC Ae. 2010)

Tests have been carried out on thick symmetrical airfoils and on a 40 percent thick airfoil with 10 percent camber. The symmetrical wings at low Reynolds numbers have normal lift curves, but at higher values of R the slope of the lift curve is negative at zero incidence, and positive lift is not obtained until $\alpha = 10^{o}$ for the forty percent section and $\alpha = 15^{o}$ for the 50 percent section. The effect of surface roughness was tried on the thicker section: it was to cause the change of lift slope from positive to negative to take place at a lower Reynolds number for the rough airfoil than for the smooth one.

N-7290*

Aeronautical Research Council (Gt. Brit.) EXPERIMENTS ON TWO PIERCY AEROFOILS IN THE COMPRESSED AIR TUNNEL. D. H. Williams, A. H. Bell and W. G. Raymer. 1950. 25p. diagrs., 9 tabs. (ARC R & M 2459. Formerly ARC 4164; ARC Ae. Techl. 1570)

Two symmetrical airfoils, 12 percent and 20 percent thick, having their maximum thickness at 0.40c, have been tested up to $R = 7 \times 10^{6}$ to find the effect on drag of moving the position of maximum thickness back. The sections were also tested with 15 percent split flaps. The thicker section was tested with square wing tips and with circular beadings on the wing tips.

N-7342*

Aeronautical Research Council (Gt. Brit.) WIND-TUNNEL EXPERIMENTS ON THE SQUIDDING OF PARACHUTES. L. F. G. Simmons, R. W. F. Gould and C. F. Cowdrey. 1951. 19p. diagrs., photos., tab. (ARC R & M 2523. Formerly ARC 7062; ARC Ae. 2353)

The experiment was to determine the cause of the collapse of a parachute, known as "squidding". Measurements of pressure were made in a wind tunnel over the surfaces of rigid models representing (a) a fully inflated canopy (b) a semi-squidded shape, and also at points over the surface of a small parachute. Each rigid model was uniformly perforated with holes representing a degree of porosity which was varied in some of the tests. Tests on the parachute were made with it tethered, (1) with rigging lines to a fixed point, (2) by wires to the sides of the tunnel.

N-7368*

Aeronautical Research Council (Gt. Brit.) FLIGHT MEASUREMENTS OF PROFILE DRAG AT HIGH SPEEDS. W. A. Mair. 1951. 11p. diagrs., 2 tabs. (ARC R & M 2555; ARC 5990. Formerly RAE Aero 1767)

Using a pitot-traverse method, the profile drag of an 18 percent thick wing section has been measured, both in level flight and in dives, at Mach numbers up to about 0.7. The pressures in the wake were measured by means of air-speed indicators and recorded photographically. At the theoretical critical speed of the wing (M = 0.66), the increase of profile-drag coefficient due to compressibility is about 8 percent. At higher speeds the drag coefficient increases rapidly with Mach number.

N-7369*

Aeronautical Research Council (Gt. Brit.) GRAPHICAL TREATMENT OF BINARY MASS-BALANCING PROBLEMS. R. A. Frazer. 1951. 10p. diagrs., 3 tabs. (ARC R & M 2551. Formerly ARC 6059; ARC 0.282)

A graphical method, based on "classical" flutter theory, is described which provides a simple test of the effectiveness of mass-balancing in the prevention of flutter at various heights. Illustrative applications are made to flexural-aileron and servorudder flutter. It is suggested that diagrams of this type may be a useful aid in design.

N-5960*

Aeroplane and Armament Experimental Establishment (Gt. Brit.) FIREBRAND TF. MK. 5A EK.732 (CENTAURUS 9). BRIEF HANDLING TRIALS WITH POWER-ASSISTED AILERON CONTROL. September 19, 1950. 5p. (AAEE Rept. A.A.E.E./787,d, pt.10)

The operation of the aileron control was investigated on the ground, with and without power assistance. The aileron control, with power assistance, was assessed in flight under the following conditions:- take-off, cruise, turns and rolls, dives, glides, stalls and landing. The operation of the "Emergency" change over control (i.e. to "manual" control and vice versa) was investigated in flight. The aileron control in "Emergency" was assessed in cruising flight and in airfield landings.

N-6514*

Aeroplane and Armament Experimental Establishment (Gt. Brit.) PRINCE WF. 136 (2 LEONIDES 24). HANDLING TESTS. September 28, 1950. 16p. photos. (AAEE Rept. A.A.E.E./869, pt. 1)

Subject to certain modifications, which were incorporated during the trials, the Prince was considered to have good flight and satisfactory ground handling characteristics and to be suitable up to a weight of 11,000 lb. for communications duties from land bases. A number of points to which pilots' attention should be drawn are included in the report, together with cockpit criticisms in relation to instrument and night flying.

N-7179*

Aeroplane and Armament Experimental Establishment (Gt. Brit.) SYCAMORE MK. 1 VL. 958 (WASP JUNIOR). PERFORMANCE AND HANDLING TRIALS. October 31, 1950. 32p. diagrs., photos., 1 tab. (AAEE Rept. A.A.E.E./874, pt.1)

Performance and handling tests have been made on a Sycamore Mk. 1 helicopter at an initial take-off all-up weight of 4850 lb. In general, the control characteristics of this aircraft are considered to be better than those of other current helicopters. The aircraft is easy and comfortable to fly except at high speed, and maneuverability and autorotational characteristics are good.

N-5847*

Forest Products Research Lab. (Gt. Brit.) THE DIELECTRIC PROPERTIES OF WOOD. I. PRELIMINARY EXPERIMENTS ON AIR-DRY WOOD. R. F. S. Hearmon and J. N. Burcham. July 1950. 13p. diagrs., 7 tabs. (Forest Products Research Lab.)

The dielectric constant and loss tangent of 12 air-dry timbers have been measured over the frequency range 1 to 60 megacycles per second by a resonance method. Alternative representations of dielectric properties, for instance in terms of attenuation coefficient and refractive index of electromagnetic waves, are discussed, and numerical values of these quantities are given. There is a close connection between dielectric constant and density, but no such relation exists for loss tangent, although there is a general tendency for the higher values to be associated with the higher densities.

1115.5-Goettingen 623/lf*

Ministry of Supply (Gt. Brit.) SWEPT-BACK WINGS AT HIGH SPEED. (Pfeilfluegel bei Hohen Geschwindigkeiten). H. Ludwieg. 13p. diagrs., tab. (MOS GDC 10/6081K/T; R & T 386. Trans. from Lilienthal-Gesellschaft für Luftfahrtforschung Bericht 127, p. 44-52).

Properties of an airfoil in the vicinity of the speed of sound can be much improved by a considerable sweep-back, according to suggestions by Betz and Busemann. It is not possible to fly with an infinitely long, yawed and strongly sweptback wing; for, in the center section of a single wing, the flow would be similar to that of an infinitely long wing. In the center of the sweptback wing and at the wing tip, certain deflections will take place. To test these considerations, a few small model wings with different angles of sweepback were tested in the wind tunnel, at high speeds.

N-7134*

National Gas Turbine Establishment (Gt. Brit.) FINAL REPORT ON THE ENGINE TESTING AND FAILURE INVESTIGATION OF NO. 2 DESIGN OF LAMINATED TURBINE DISC. E. Glenny, C. Grantham and T. A. Taylor. November 1950. 57p. diagrs., photos., 2 tabs. (NGTE R. 78)

A laminated turbine disk was tested. Throughout, the jet pipe temperature was controlled by means of a variable nozzle. After 73 hours 57 minutes failure of the outer lamination at the compressor occurred. On subsequent testing, after 10 hours, failure of the adjacent compressor face lamination occurred. For both, lamination failure occurred in the peening groove across the bottom serrations of 25 and 17 consecutive tongues, respectively. Examination of the microstructure indicated failure had taken place by creep.

N-6004*

Royal Aircraft Establishment (Gt. Brit.) NOTES ON ATOMISER RESEARCH DONE BY PROF. HOTTEL, M.I.T., U.S.A. W. R. Hawthorne. June 1943. 5p. diagrs. (RAE Tech. Note Eng. 167)

Experiments have been done with heavy oils of Bunker C quality and most of the work was done with a Todd 58 x 40 atomizing nozzle. This included investigations of (1) particle size distribution, (2) effect of viscosity, nozzle design and pressure on particle size, (3) effect of viscosity and orifice dimensions on discharge coefficients and spray angle, and (4) the pressure required to obtain a useful spray.

N-6325*

Royal Aircraft Establishment (Gt. Brit.) FLUTTER TESTS ON THE INFLUENCE OF THE AERODYNAMIC BALANCE OF AILERONS. (Flatterversuche über den Einfluss des aerodynamischen Ruder-Innenausgleichs). F. Walter. 36p. diagrs., tab. (RAE Library Trans. 301. Trans. from ZWB FB 1664)

The influence of aerodynamic balance on the critical speed of a wing with aileron was investigated. The following quantities have been varied: The position of the control hinge, the shape of the trailing edge surface, the natural frequency of the aileron, and the position of the inertia axis of the aileron.

N-6903*

Royal Aircraft Establishment (Gt. Brit.) THE ABSORPTIOMETRIC DETERMINATION OF TUNGSTEN AS THIOCYANATE. A. Bacon. January 1951. 10p. diagrs., 5 tabs. (RAE Met. 63)

Some experiments are described on the thiocyanate reaction with tungsten and reduction of the complex by titanous chloride. The application of the reaction to the determination of tungsten in steel over the range 0 - 0.8 percent is described in detail.

N-6926*

Royal Aircraft Establishment (Gt. Brit.)
TESTS OF A WATER SPRAY RIG FOR SIMULATING ICING CONDITIONS AHEAD OF A TURBINE ENGINE IN FLIGHT. Staff of Mechanical Engineering Department. October 1950. 11p. diagrs., photos. (RAE Tech. Note Mech. Eng. 58)

A water spray rig, for testing gas turbine engines under artificial icing conditions in flight, was designed and tested. The spray nozzles were of the air blast type, and the mean droplet size produced in flight by the nozzles with a moderate applied air pressure, was in the desired range of 20 to 30 microns. The compressed air for the nozzles was obtained from the engine compressor but flight tests have shown that, at altitude with ambient temperatures of -30°C and below, the air was not hot enough to prevent the nozzles from freezing.

N-6930*

Royal Aircraft Establishment (Gt. Brit.)
FLUTTER EXPERIMENTS ON THE INFLUENCE OF AERODYNAMIC BALANCE ACHIEVED BY MEANS OF A GEARED TAB. (Flatterversuche über den Einfluss des aerodynamischen ausgleichs durch Weggesteuertes Hilfsruder). H. Voigt, F. Walter and W. Heger. February 1950. 85p. diagrs., photos., 2 tabs. (RAE Library Trans. 318)

For frequency ratios aileron frequency/wing torsional frequency below 0.7 to 0.9 the critical speed for the arrangements investigated increases considerably as full aerodynamic balance is approached, for frequency ratios above 1.0 it drops somewhat. For ratios between 0.7 and 1.0 there exists a pronounced minimum of the critical speed and only a slight influence of the aerodynamic balance. Various forms and arrangements of tabs are investigated. Further measurements supply observational data concerning the influence of the aileron center of mass, of increased coupling between bending and torsion of the wing, and of wing rigidity in bending.

N-7136*

Royal Aircraft Establishment (Gt. Brit.)
SOME CREEP PROPERTIES OF INCONEL X AT 815° C. N. H. G. Daniels and L. W. Larke. November 1950. 18p. diagrs., photos., 4 tabs. (RAE Met. 58)

R.A.E. had agreed to take part with other laboratories in this country, in Canada, and in the U. S. A., in a series of cooperative creep tests sponsored by the National Research Council, Canada. This involved a series of creep tests at 815° C (1500° F) and stresses of 16,000, 18,000, 22,000 and 25,000 lb/in^2. Some data are given on the scatter obtained in testing this type of material.

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